

Power Distribution Limits

Westinghouse Technology
Systems Manual Section 2.2



Objectives

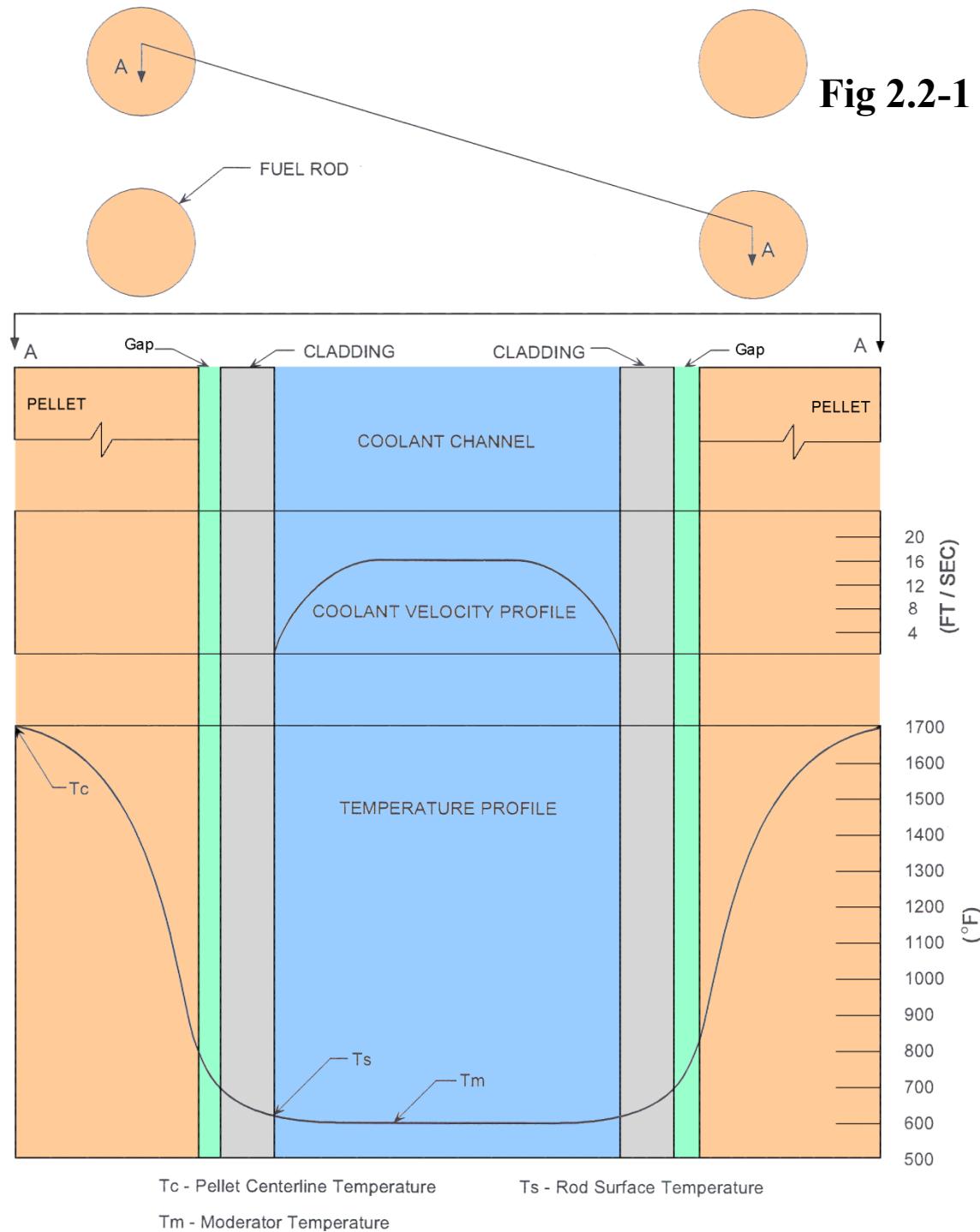
1 Define the following terms:

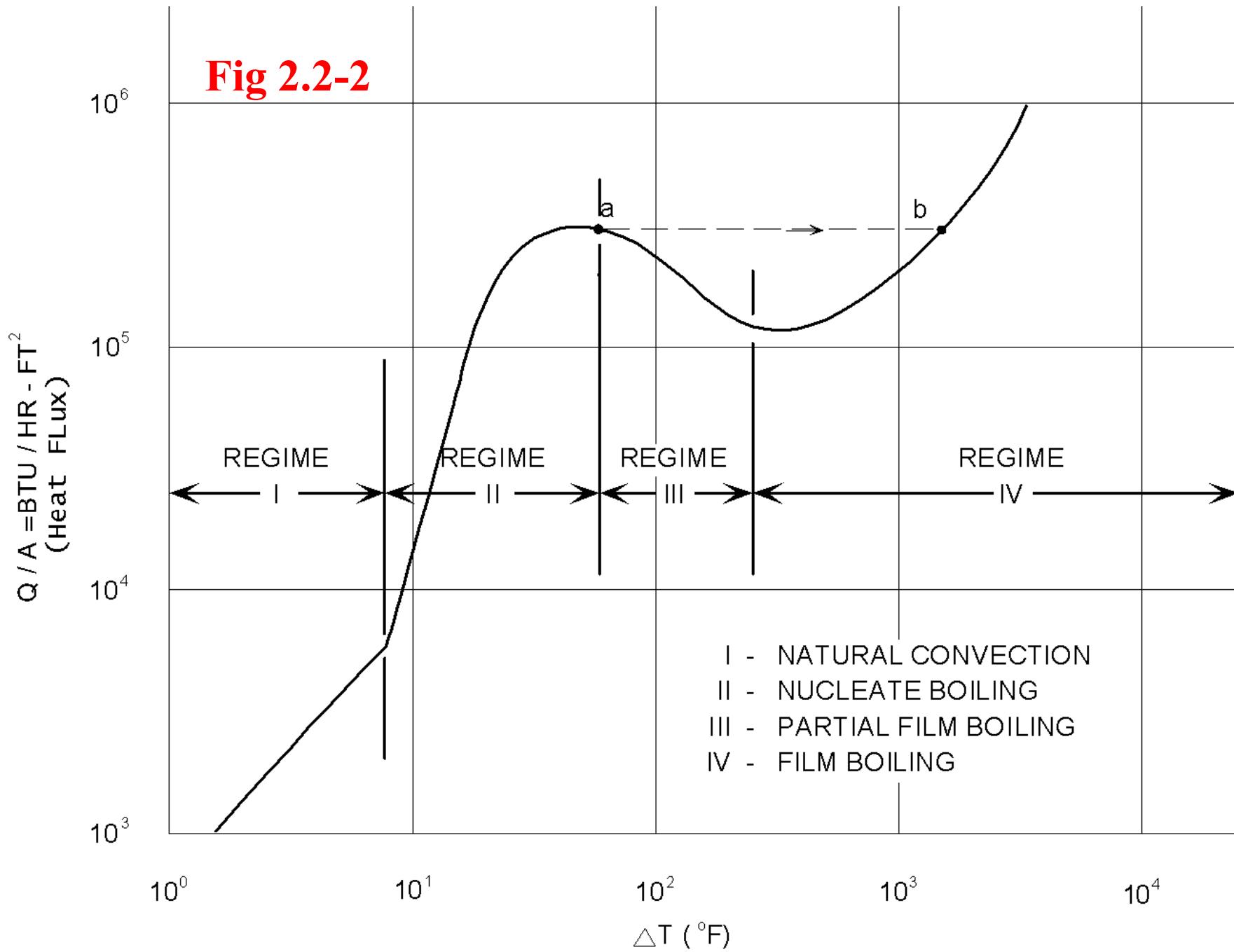
- Departure from nucleate boiling (DNB)
- Departure from nucleate boiling ratio (DNBR)
- Power density (linear heat generation rate)
- Heat flux hot channel factor (F_Q)
- Axial flux difference (AFD)
- Enthalpy rise hot channel factor ($F_{\Delta H}^N$)
- Quadrant power tilt ratio (QPTR)

Objectives (Continued)

- 2 Explain why DNBR is required to be greater than a specific limit.
- 3 Explain why F_Q limit is varied as a function of core height.
- 4 Explain why surveillance intervals of 31 effective full power days are adequate to ensure that peaking factor limits are not exceeded.
- 5 Explain how AFD limits ensure F_Q is not exceeded.

Fig 2.2-1





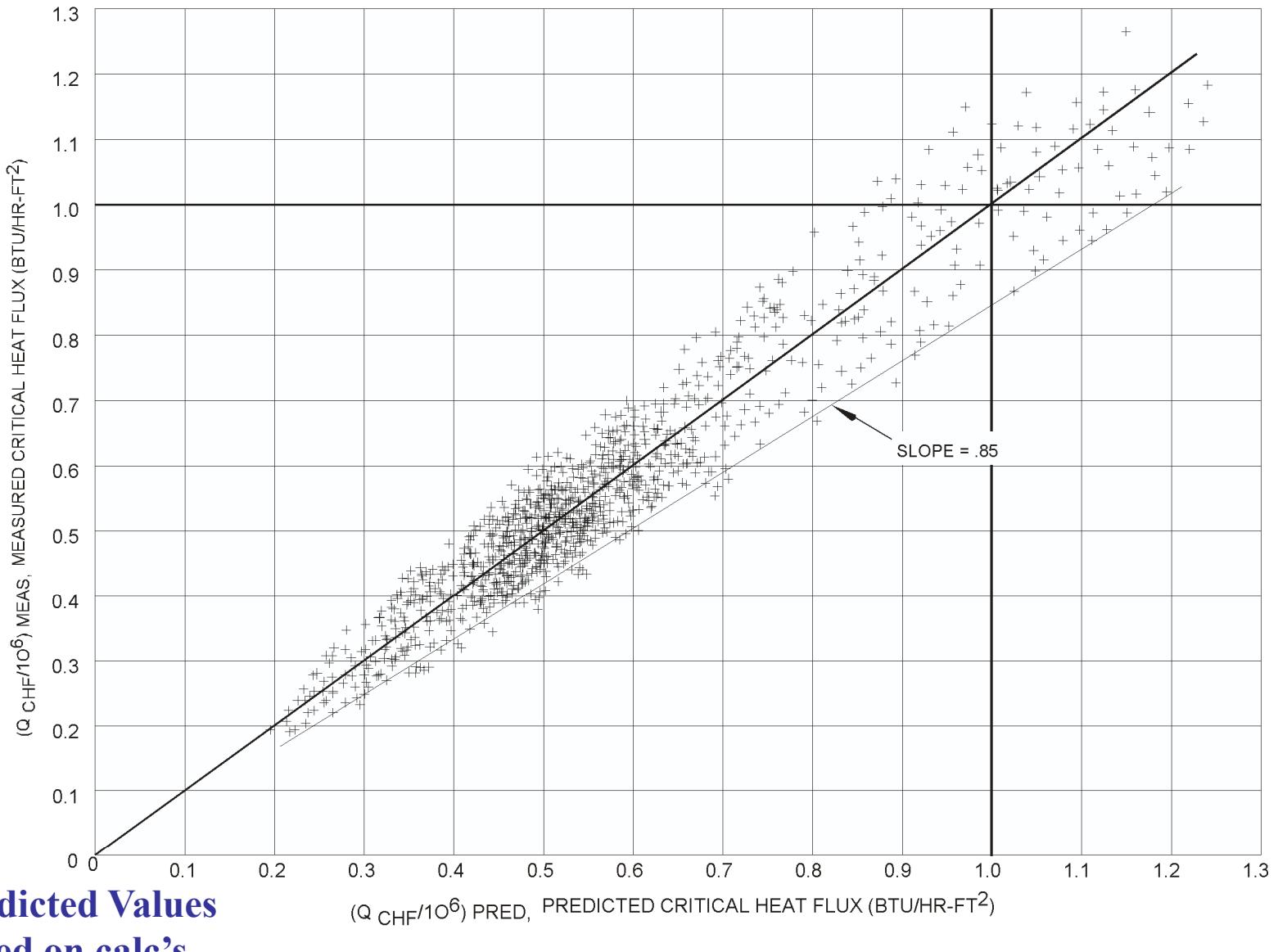
(Temperature difference between surface of the wire and saturation temperature of the water)

DNBR

$$DNBR = \frac{\text{the heat flux required to reach DNB}}{\text{the actual heat flux}}$$

Or,

$$DNBR = \frac{CHF}{AHF}$$



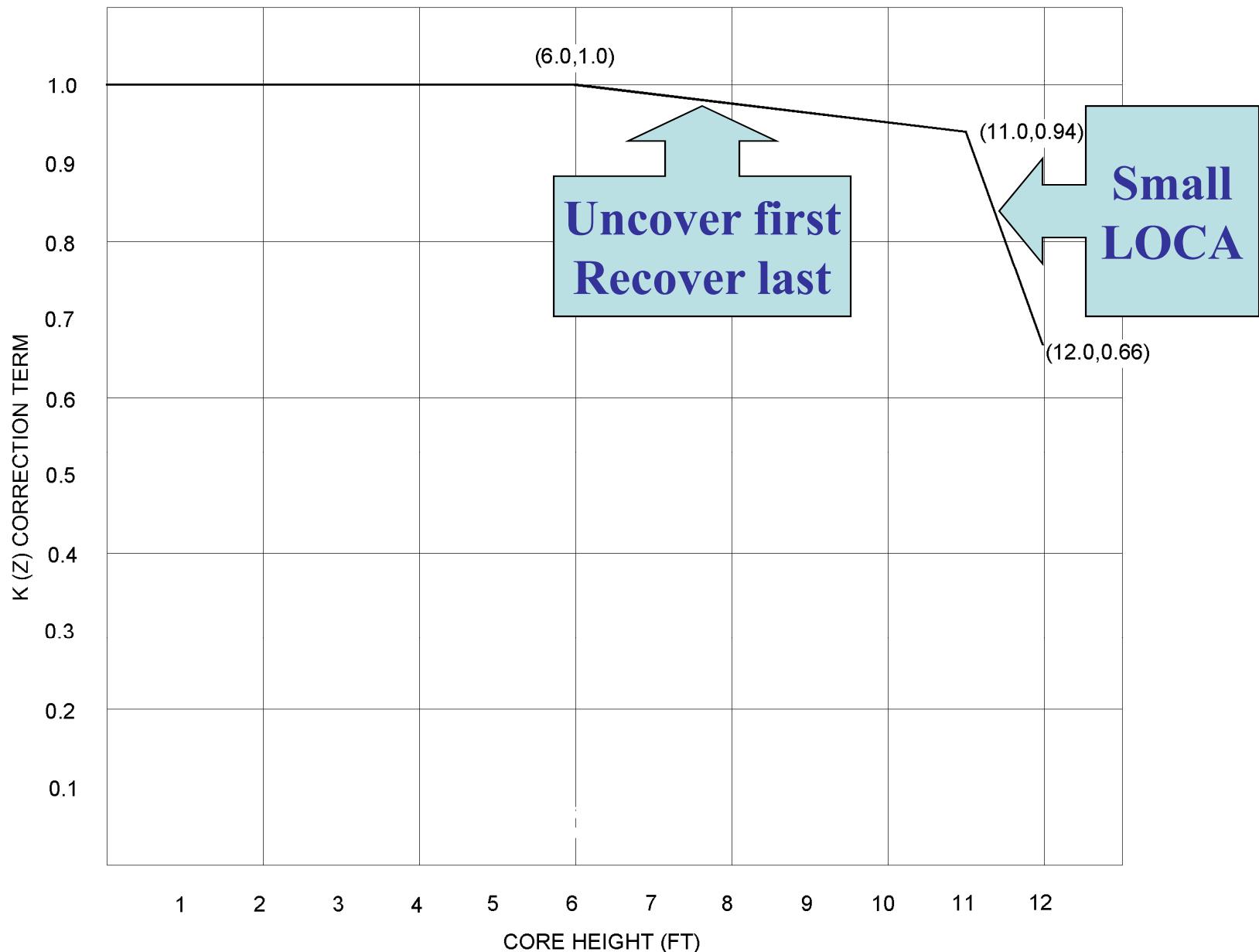
**Predicted Values
based on calc's**

Fig 2.2-3

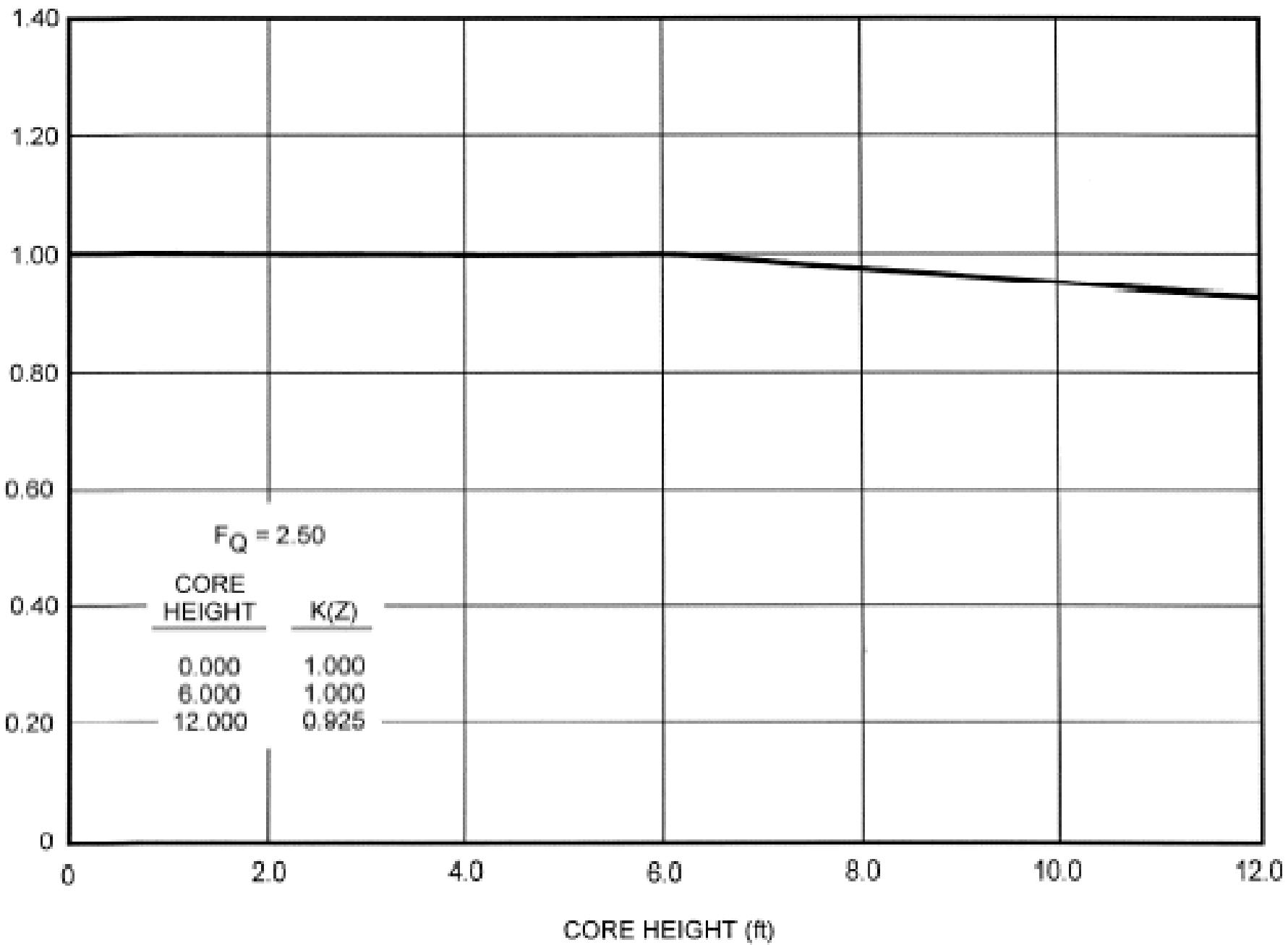
Figure 2.2-3 Measured versus Predicted Critical Heat Flux

Heat Flux Hot Channel Factor - F_Q

$$F_Q = \frac{\text{Maximum (Peak) kw/ft}}{\text{Average kw/ft}}$$



K(Z) - NORMALIZED PEAKING FACTOR



Nuclear Enthalpy Rise HCF

- The nuclear enthalpy rise hot channel factor, is defined as the ratio of the maximum integrated rod power to the average integrated rod power.
- **Purpose is to prevent localized DNB.**
- Measured periodically using incore flux detectors.

Quadrant Power Tilt Ratio

- Quadrant Power Tilt Ratio (QPTR) is the ratio of the maximum upper excore detector calibrated output to the average of the upper excore detector calibrated outputs, or the ratio of the maximum lower excore detector calibrated output to the average of the lower excore detector calibrated outputs, whichever is the greatest.

$$\text{QPTR} = \frac{\text{Max Upper (or Lower) Excore Detector Current}}{\text{Ave Upper (or Lower) Excore Detector Currents}}$$

Axial Flux Difference (AFD)

$$\Delta I = \phi_T - \phi_B$$

Where:

ΔI = Axial Flux Difference

ϕ_T = Flux Signal from the top 1/2 of power range detector

ϕ_B = Flux Signal from the bottom 1/2 of power range detector

Where ϕ is expressed as % RTP

Relaxed AFD Limits

